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REPELLENTS REDUCE DEER BROWSING ON PONDEROSA PINE SEEDLINGS

by

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Winter range for many central Oregon mule deer herds includes the lower elevation areas of the ponderosa pine forests. Clear-cut logging and broadcast slash burning during the 1920's and early 1930's created reforestation problems in these areas. These timber management practices provided good conditions for natural regeneration of deer browse and cover plants, including antelope bitterbrush (Purshia tridentata), snowbrush ceanothus (Ceanothus velutinus), and pine manzanita (Arctostaphylos parryana var. pinetorum). This inadvertant improvement of habitat attracted deer and probably favored population increases.

Repeated attempts have been made to reforest these areas with ponderosa pine nursery stock. In many instances, complete failures occurred. In other cases, survival was only mediocre. Deer browsing during the fall, winter, and spring is a hazard affecting the success of many plantations in addition to careless planting, harsh sites, mortality due to rodents, insects, and disease, and unknown mortality causes. Browsed trees that do survive are deformed, and growth is retarded (fig. 1).

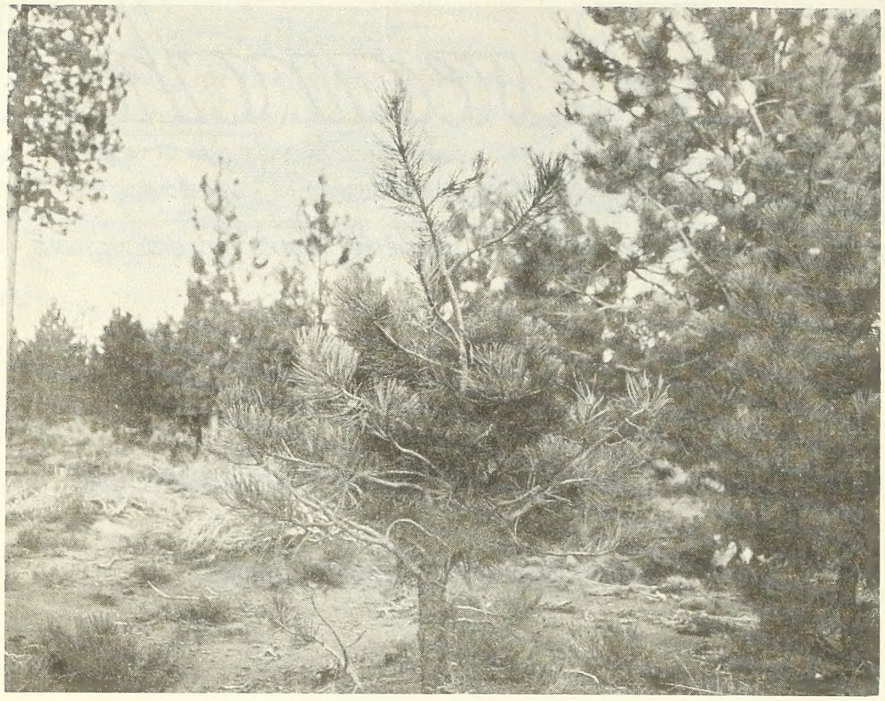

Figure 1.--Repeated deer browsing of this 27-year-old ponderosa pine has produced a stunted and malformed tree.

Fencing and wire cages have been used to protect planted seedlings from browsing. However, emphasis is now being placed on the use of foliar chemical repellents[1/] and systemic compounds.[2/]

[1/] Besser, Jerome F., and Welch, Jack F. Chemical repellents for the control of mammal damage to plants. 24th No. Amer. Wildl. Conf. Trans. 1959: 166-173.

[2/] U.S. Bureau of Sport Fisheries and Wildlife. Wildlife research progress--1961. Fish & Wildl. Serv. Cir. 146, 50 pp. 1962.

THE STUDY

The effectiveness of three chemical foliar repellents, ZAC (zinc dimethyldithiocarbamate cyclohexylamine complex), TMTD (tetramethylthiuram disulfide), and copper omadine (the copper salt of 1-hydroxy-2-pyridine thione), for reducing deer browsing on planted ponderosa pine seedlings was tested from 1958 to 1960 on a site IV that had been logged about 1933.[3/] Each chemical, applied as a spray, was formulated as an aqueous suspension containing 10 percent of the active ingredient, 10 percent acrylic resin adhesive (Rhoplex AC-33), 0.2 percent Methocel (a thickening agent), and 0.6 percent Hexadecanol-ethanol (a defoaming agent).[4/]

In April of 1958, sixty 2-0 ponderosa pine seedlings were handplanted with 8- by 8-foot spacing in each of 15 plots. The plots were separated into three groups of five plots each. All trees in one plot of each group were subjected to one of the following treatments: (1) spraying with ZAC, (2) spraying with TMTD, (3) spraying with copper omadine, (4) piling brush around seedlings, and (5) control with no spray and no brush piling.

Each seedling in the spray treatments was thoroughly wetted with the respective chemical formulation immediately after planting.

[3/] A cooperative study with the Pacific Northwest Forest & Range Experiment Station, U.S. Bureau of Sport Fisheries and Wildlife, and the Deschutes National Forest. The Experiment Station designed the experiment, laid out the field plots, and provided statistical analyses of the data. Chemicals, formulations, and method of application were suggested and provided by the Denver Wildlife Research Center, Bureau of Sport Fisheries and Wildlife. The Deschutes National Forest furnished land, tree seedlings, and seedling planting.

[4/] A ZAC formulation may be obtained commercially as Improved Z.I.P. A TMTD formulation is available as Selco TMTD-Rhoplex Rabbit and Deer Repellent Concentrate. TMTD may also be obtained as Arasan 75 or Arasan 42-S to which the adhesive, defoaming, and thickening agents must be added. No commercial supply of copper omadine is known. This does not constitute an endorsement of products by the Forest Service.

A hand-operated pressure tank sprayer was used. About 3 quarts of solution were needed for the 180 trees in each repellent treatment. At the same time, brush was piled around seedlings selected for this treatment. Subsequent sprayings and brush rearrangements were made in September 1958 and September 1959 to protect new growth.

Starting in June 1958, observations were made at 4-month intervals until June 1960. Each seedling was examined for evidence of browsing. When dead or missing seedling spots were found, an attempt was made to determine the cause of death.

RESULTS AND DISCUSSION

Effectiveness of the Treatments

None of the treatments prevented all browsing, but both chemical and mechanical protection significantly reduced the amount of browsing as compared with no protection (fig. 2). Also, all chemical sprays resulted in significantly fewer browsed seedlings as compared with mechanical protection. On the average, no chemical formulation was superior to the others.

For the 2 years, 32 percent of the unprotected live seedlings were browsed. This compares with only 18-percent browsing of the mechanically protected seedlings and 10-, 7-, and 7-percent browsing of seedlings sprayed with copper omadine, TMTD, and ZAC formulations, respectively. Less browsing might be expected on those

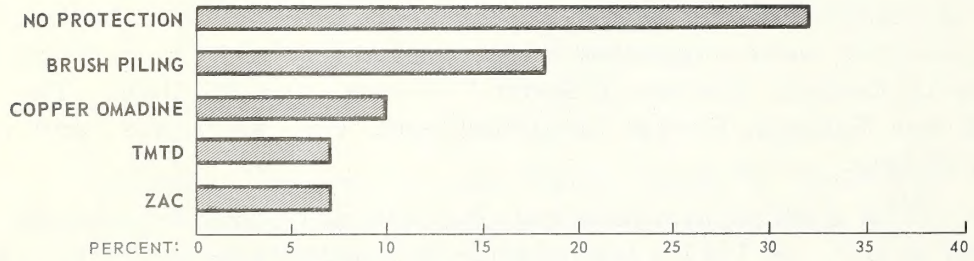

Figure 2. -- Percent of live ponderosa pine seedlings browsed, June 1958 to June 1960.

trees protected by brush piling. However, high winds during the winter and spring blew the brush covering off some seedlings and exposed them to browsing.

Equally important to the general effectiveness of the various treatments is the protection each provided during various seasons. Figure 3 summarizes the intensity of browsing of live ponderosa pine seedlings, by treatment, during three seasonal periods.

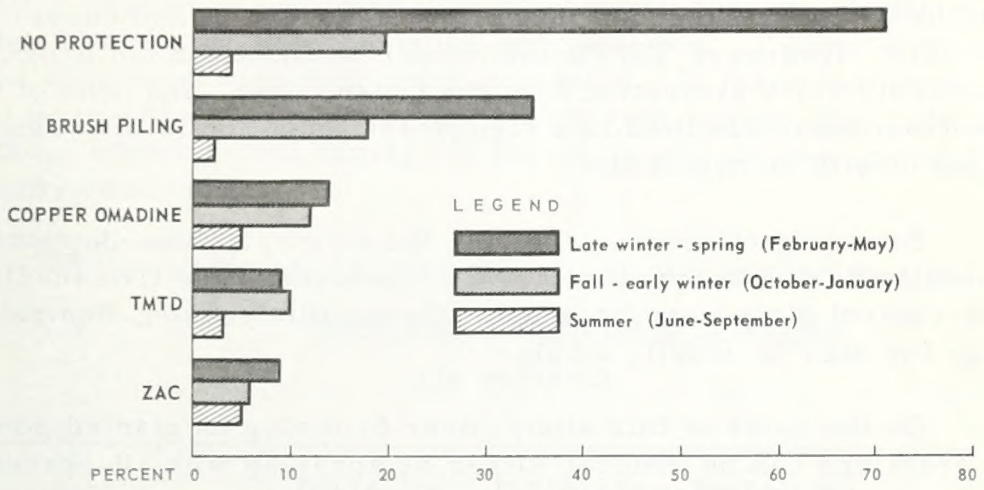

Figure 3.--Seasonal browsing intensity of live ponderosa pine seedlings, June 1958 to June 1960.

The period when most browsing occurred, when protection was most necessary, was in the late winter–spring season from February through May. Deer browsed 71 percent of the unprotected live seedlings during this season as compared with 20 percent in the fall–early winter season (October-January) and only 4 percent in the summer (June-September). This late winter–spring season corresponds to the time when winter deer forage produced the preceding year becomes scarce and spring growth has not reached a maximum.

All of the protective treatments significantly reduced the amount of browsing during the late winter–spring period as compared with the control. Only 35 percent of the brush-covered seedlings were browsed. However, the brush-covering treatment was not as

effective as any of the three chemical sprays. Only 14, 9, and 9 percent of the live seedlings were browsed in the copper omadine, TMTD, and ZAC treatments, respectively. The differences in the amount of protection afforded by the chemical formulations were not significant during this season.

ZAC appeared to be the most effective protectant during the fall--early winter season (October-January). Only 6 percent of the live seedlings treated with this formulation were browsed. This amount is significantly less than the 18 and 20 percent browsed in the brush-covered and control plots but is essentially no different from the 10- and 12-percent browsing in the TMTD and copper omadine plots. However, TMTD and copper omadine did not provide appreciably more protection than the brush cover, and none of these three treatments resulted in a significant reduction in browsing as compared with no protection.

Browsing of seedlings during the summer (June-September) appears to be inconsequential. Only 4 percent of the live seedlings in the control plots were browsed. During this season, desirable forage for deer is usually ample.

On the basis of this study, deer browsing on planted ponderosa pine seedlings can be reduced either by spraying with 10-percent formulations of ZAC, TMTD, or copper omadine or protecting each seedling with brush. The ZAC formulation appears to be the most effective treatment since it provides more overall protection during the critical time of the year, fall through winter. The operation is not a one-shot procedure, however. Even though the additives used (adhesive, thickening, and defoaming agents) weather well,[5/] the seedlings must be sprayed each year to protect new growth. The spraying should be done in the fall, after current growth is complete, to insure total coverage of all new plant material and maximum available protection during subsequent severe weather conditions and deer concentrations. The number of years spray treatments must be carried out was not determined.

[5/] Besser, Jerome F. Special report--effectiveness of repellent treatments for protection of trees from animal damage (1956-57). U.S. Bur. Sport Fisheries & Wildl. Wildl. Res. Lab., Denver, Colo., 19 pp. (mimeo.) (n.d.)

Mortality

Approximately 48-percent mortality (434 seedlings) occurred among the test seedlings. This loss was not due to toxic action of the chemical formulations.[6/]

Mortality by causes other than recognizable animal damage accounted for 75 percent of the total loss (table 1). Most of these seedlings died during the summer (39 percent of total mortality) and death could be attributed to combinations of low soil moisture and high soil surface temperature conditions, possible competition from existing vegetation, or mortality by unknown causes. Death of some of these seedlings was caused by poor planting. Evidence of this was noted when dead seedlings were excavated. In many instances, root ends were either upturned or the entire root system was tightly compacted. Planting-tool damage to the roots was another cause of death of many seedlings.

Table 1.--Mortality analysis of 434 dead ponderosa pine seedlings 2 years after planting

(In percent)

Season	Mortality caused by deer	Mortality caused by gophers	Mortality by other causes[1/]	Total mortality
Summer (June-Sept.)	--	5	39	44
Fall--early winter (Oct.-Jan.)	1	7	25	33
Late winter--spring (Feb.-May)	--	12	11	23
Total	1	24	75	100

[1/] Mortality by other causes includes poor planting (roots upturned, compacted, or damaged by planting tool), drought, high soil temperatures, possible competition from existing vegetation and unknown factors.

[6/] See footnote 5.

Gophers had killed 24 percent of all dead trees. Half of these, 12 percent of the total number of dead trees, were killed during the late winter-spring season. The rest of the gopher kills occurred in about equal numbers during the summer and fall-early winter seasons.

Only 1 percent of the total number of dead trees could have been killed by deer. In all cases, mortality by this cause occurred during the summer, and the seedlings affected had been heavily browsed during the late winter-spring season. Death by deer may have been secondary and associated with other causes since many other heavily browsed seedlings survived.

SUMMARY

Deer browsing of ponderosa pine seedlings can be reduced by spraying with 10-percent solutions of either zinc dimethyldithiocarbamate cyclohexylamine complex (ZAC), tetramethylthiuram disulfide (TMTD), or copper omadine, each mixed with 10 percent acrylic resin adhesive (Rhoplex AC-33), 0.2 percent Methocel (a thickening agent), and 0.6 percent Hexadecanol-ethanol (a defoaming agent). Covering with brush also reduces browsing. ZAC provides the most effective protection on a year-round basis.

The spray treatment must be applied each year to provide protection to yearly growth. This should be done in the fall after current growth is completed and before deer concentrate in plantation areas. The number of years spray treatments must be carried out was not determined.

Seedling mortality was high (48 percent) during the 2-year study period. Death by causes other than recognizable animal damage accounted for most of the loss. Seasonal mortality was greatest during the summer.